Remarks/Arguments:

The present invention relates to a consumable electrode welding machine. The welding machine includes a welding voltage detection circuit, a welding current detection circuit, a short-circuit arc judgment circuit, a short-circuit waveform control circuit, an arc waveform control circuit, and a switching circuit. The welding machine further includes a resistance calculator for calculating and outputting a resistance signal. The resistance signal is inputted to at least either one of the short-circuit waveform control circuit and the arc waveform control circuit, for controlling the welding power. When the short-circuit arc judgment circuit judges that the machine is in the short-circuit state, the short-circuit waveform control circuit controls the welding voltage to decrease or increase when the resistance signal exceeds or is below the first resistance threshold, respectively.

Claims 1-8 are presently pending in the application. With this Amendment, claims 1-8 has been amended. No new matter has been added.

Claims 1-8 are rejected under 35 U.S.C. § 103(a) as being unpatentable over JP Patent publication No. 410109163 A (hereinafter "Kawamoto") in view of U.S. Patent No. 6,248,976 B1 (hereinafter "Blankenship") and U.S. Patent No. 1,687,492 (hereinafter "Churchward"). It is respectfully submitted, however, that the claims are patentable over the art of record for at least the reasons set forth below.

Kawamoto is drawn to a consumable electrode type DC arc welder wherein, in a short-circuit period, current control is performed, and in an arc period, voltage control is performed. Blankenship is drawn to a method of generating a real time control signal for use in an electric arc welding process including determining a derivative of the welding voltage with respect to the welding current to generate a control signal which varies with the magnitude of arc resistance and is used as a direct correlation to the voltage of the arc. Churchward is drawn to an electric welding apparatus regulating the welding current as to maintain at the arc a constant current in order to stabilize the arc regardless of variations in resistance as may occur incident to variations in the length of the arc.

Applicants' invention, as recited by claim 1 includes a feature which is neither disclosed nor suggested by the art of record, namely:

> ... the machine further **comprises a resistance calculator** for calculating a resistance signal based on the welding voltage detection signal and the welding current detection signal, and the resistance signal is delivered to the short-circuit waveform control circuit and the arc waveform control circuit for controlling the welding power, wherein,
>
> when the short-circuit arc judgment circuit judges the machine is **in the short-circuit state**, the short-circuit waveform control circuit **controls the welding voltage to decrease** when the resistance signal exceeds a first resistance threshold, **controls the welding voltage to increase** and the short-circuit period to decrease when the resistance signal is below the first resistance threshold ...

This feature describes the welding machine characterized by controlling a welding voltage in a short-circuit period. The welding machine first detects the resistance in a short-circuit period and in an arc period from the detected welding voltage and welding current, then lower the welding voltage when the detected resistance is increased when the resistance signal exceeds a first resistance threshold in a short-circuit period, or raise the welding voltage when the detected resistance in a short-circuit period is small when the resistance signal is below the first resistance threshold. This feature is found in the first exemplary embodiment of the originally filed application at page 2, paragraph [0049], and page 3, paragraphs [0050] and [0051]. No new matter has been added.

Regarding independent claim 1, Kawamoto is relied upon, on page 3 of the Office Action, as disclosing "... a consumable electrode type arc welding machine which makes use of an arc generated between a base metal of welding and a wire supplied thereto (para. 0002-0003)", and on page 6 of the Office Action, as disclosing "... all of the limitations of the claimed invention...". As admitted in the Office Action, Kawamoto fails to disclose an arc resistance calculator for calculating and outputting an arc resistance signal delivered to at least one of the short-circuit waveform control circuit and the arc waveform control circuit for controlling the welding power. The Office Action asserts that Blankenship teaches an arc resistance calculator for calculating and outputting an arc resistance signal, and the arc resistance signal is delivered to at least one of the short-circuit waveform control circuit and the arc waveform control circuit for controlling the welding power (col. 2, lines 6-38), and Blankenship further teaches such a configuration provides a means the arc length can be maintained during the welding process (col. 2, line 20-23). The Office Action further asserts that, similarly, Churchward teaches the welding current to be held at a constant level when the arc resistance exceeds the resistance threshold, the constant level current being greater

than a normal welding current generated based on the welding voltage (page 1, lines 67 - page 2, lines 35). Churchward also teaches when the arc resistance signal continues exhibiting a value that is greater than a certain specific value (page 1, lines 79-81). Churchward further teaches such a configuration provides a means to overcome such increase in resistance and necessary to supply a greater voltage to the work to maintain a constant flow of current across the arc (page 1, lines 81-85).

As described in paragraphs [0002] and [0003] of Kawamoto, a conventional D.C. arc welder performs voltage control in an arc period, and **current control in a short circuit period** (refer to the volume for 2 pieces of weld bonding manual Japan Welding Society). That is, Kawamoto does not teach or suggest about control of voltage in a short-circuit period.

Blankenship, in col. 2, lines 6-38, discloses the concept of sensing the derivative of voltage with respect to current, a parameter (dV/dI), to give a resistance function that ignores current. This parameter is used to determine the **voltage across the arc** as well as maintaining the length of the arc. Accordingly, Blankenship does not teach or suggest about control of voltage in a short-circuit period.

Churchward, in page 1 line 67-page 2 line 35, discloses **maintaining an arc current in order to stabilize the arc** regardless of the variations in the length of the welding arc resulting in the variations of the resistance. Accordingly, Churchward does not teach or suggest about control of voltage in a short-circuit period.

Kawamoto in view of Blankenship or Kawamoto in view of Churchward is different from the Applicants' claim 1, because as discussed above, Applicants claim the welding machine further includes a resistance calculator for calculating a resistance signal based on the welding voltage detection signal and the welding current detection signal, and the resistance signal is delivered to the short-circuit waveform control circuit and the arc waveform control circuit for controlling the welding power, wherein, when the short-circuit arc judgment circuit judges the machine is in the short-circuit state, the short-circuit waveform control circuit controls the welding voltage to decrease when the resistance signal exceeds a first resistance threshold, controls the welding voltage to increase and the short-circuit period to decrease when the resistance signal is below the first resistance threshold. This is different from Kawamoto because Kawamoto, as admitted in the Office Action, fails to disclose an resistance calculator.

Even if Kawamoto did disclose, teach or suggest including an resistance calculator, Kawamoto does not teach or suggest a control of voltage in a short-circuit period.

Furthermore, Blankenship fails to overcome the deficiencies in Kawamoto. As described in Blankenship, column 2, lines 24-38, a unique parameter, voltage relating to current, (dV/dI) is used as a control signal as a representation of arc resistance for use in maintaining arc length. Therefore, Blankenship fails to make up for the deficiencies discussed above in Kawamoto.

Furthermore, Churchward also fails to overcome the deficiencies in Kawamoto. As described in Churchward, page 1, lines 76-85, in the arc state, the resistance varies in accordance with variations in the length of the arc. When the arc is lengthened, for example, the are resistance is increased and, in order to overcome such increase in resistance, it becomes necessary to supply a greater voltage to the work to maintain a constant flow of current across the arc. Therefore, Churchward also fails to make up for the deficiencies discussed above in Kawamoto.

Accordingly, Kawamoto in view of Blankenship or Churchward fails to disclose, teach or suggest each and every feature of Applicants' claim 1.

It is **because** Applicants include the feature of the welding machine including a resistance calculator for calculating a resistance signal based on the welding voltage detection signal and the welding current detection signal ... wherein, when the machine is in the short-circuit state, the welding voltage is controlled, which the following advantages are achieved. As described on page 3, paragraph [0051], lines 27-34, the welding voltage can prevent sputtering phenomenon, or, can prevent possible troubles, such as buckling of the wire.

Claim 5, while not identical to claim 1, includes features similar to claim 1. Accordingly, claim 5 is also patentable over the art for at least the reasons set forth above with respect to claim 1.

Accordingly, for at least the reasons set forth above, claims 1 and 5 are patentable over the art of record. Claims 2-4 and claims 6-8 include all of the features of claim 1 and claim 5, respectively, from which they depend. Thus claims 2-4 and claims 6-8 are also patentable over the art of record for at least the reasons set forth above.

In view of the amendments and arguments set forth above, the above-identified application is in condition for allowance which action is respectfully requested.

Respectfully submitted,

Jacques L. Etkowicz, Reg. No. 41,738
Attorney for Applicants

YJ/dmw

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P.O. Box 980
Valley Forge, PA 19482
(610) 407-0700

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